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Working Paper Series

#2010-066

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UNU-MERIT Working Papers
ISSN 1871-9872

Maastricht Economic and social Research and training centre on Innovation and Technology, UNU-MERIT

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Abstract

We examine the impact of buyer-supplier relationships within business group on capital goods trade in the context of foreign direct investment by buyer firms and capital goods producers. A simple model in which cost-reducing relationship specific investments are underlying business group ties suggests that 1) foreign affiliates of business group firms have a greater propensity to import capital goods from the home country, increasing Japanese exports 2) if the establishment of overseas affiliates by business groups firms attracts FDI by their capital goods suppliers, the 'trade creating' impact of business group ties may disappear or even be reversed. Empirical analysis of capital goods imports by 1790 manufacturing affiliates operated abroad by Japanese multinational firms in 1996 provides broad support for these predictions and demonstrates a sizeable impact of buyer-supplier ties in business groups on trade. Affiliates of member firms of horizontal and vertical business groups with supplier ties exhibit a greater propensity to import from Japan, but this impact is mitigated or transformed into a smaller import propensity if the groups' capital goods producers have substantial manufacturing investments abroad.

Keywords: Multinational firms, imports, capital goods, FDI, business groups
JEL codes: F23, F14, D21
Running head: Business groups, FDI and capital goods trade

Acknowledgements
This research is part of the research project on "Global Innovation Systems" of the Global Security Research Institute (G-SEC) at Keio University. The authors thank Banri Ito for research assistance. The paper benefitted from helpful comments on earlier drafts by Leo Sleuwaegen and participants at the EARIE annual conference and at seminars at Keio University and The Research Institute of Economy, Trade, and Industry (Tokyo).

Business Groups, Foreign Direct Investment, and Capital Goods Trade: The Import Behavior of Japanese Affiliates

1. INTRODUCTION

There has been substantial interest recently in the influence of inter-firm ties within business groups on international trade flows (see e.g. Rauch, 2001). Studies have suggested a trade creating impact of business networks through intra-group dissemination of information on overseas business opportunities, easier contract enforcement within business groups, and cross border replication of vertical trade relationships (e.g. Combes et al, 2005; Rauch, 1996; Belderbos and Sleuwaegen, 1998; Greaney 2003). In the context of Japanese business groups (*keiretsu*) the emphasis has in contrast been on the potential trade *reducing* effects, in particular of trade with firms outside the business group. Studies have suggested that long-term intra-group trade linkages within business groups are an impediment to foreign firms seeking market presence in Japan (Lawrence, 1991; Fung 199; Noland, 1992; Kreinin, 1988; Greany, 2005), although this has been disputed (Ueda and Sazaki, 1988; Weinstein and Yafeh, 1995). Spencer and Qiu (2001) show that network ties within business groups can indeed reduce imports, but that this effect can derive from efficiency enhancing behavior in buyer supplier relationships. Buyers and sellers in vertical trade relationships may prefer to invest in rent creating relationship-specific investments to improve transaction efficiency. The sunk nature of these investments creates switching costs and reduced purchases from unrelated - and thus- foreign suppliers. Head, Ries and Spencer (2004) apply this model to an empirical analysis of US auto parts exports to Japan, and confirm a negative impact of established ties within vertical business groups (keiretsu) on Japanese car parts imports.

Business group ties do not only affect trade, they also influence foreign direct investment (FDI) decisions. Prior investments by member firms in a location may create informational externalities and reduce uncertainty concerning the cost and benefits of investment locations to other firms within the group. Investments may also lead to agglomeration externalities through the provision of specialized suppliers and service providers and by inducing training of specialized labor. There is ample evidence supporting the notion that these factors cause Japanese business group members to cluster their foreign investments abroad (Belderbos and Carree, 2002; Head et al, 1994; Belderbos and Sleuwaegen, 1996; Blonigen et al., 2005; Martin et al, 1995; 1999; Smith and Florida, 1994, Henish and Delios, 2001; Belderbos, Van Olffen, and Zou, forthcoming).

Although the (potential) impact of business group ties on both trade and FDI has been established, prior empirical research has not taken these into account simultaneously.[1] In this paper, we contribute an analysis of the impact of business group ties on Japanese firms' import behavior that explicitly takes into account that business group ties can simultaneously induce FDI. We show that the trade and FDI effects of business group ties are intrinsically linked and that this interrelation leads to ambiguous effects of business group ties on trade. We extend the analysis of the trade effects of business groups by focusing on the import behavior of the foreign affiliates of Japanese firms. Using unpublished affiliate-level trade data from an official survey conducted by the Ministry of Economics Trade and Industry (METI) we empirically assess how buyer-supplier ties within vertical and horizontal Japanese business groups (*keiretsu*) influences the import trade behavior of affiliates.

We examine affiliates' imports of capital goods, i.e. manufacturing machinery. From several perspectives, we see this as an interesting focus to examine the role of business group ties on trade. Capital goods exports have also been responsible for an increasing share of Japan's trade surplus,

partly due to the investment needs of Japanese multinationals' foreign affiliates. The main vertical and horizontal business groups include manufacturing machinery producers as member firms, and long-standing supplier-buyer relationships in machinery trade within business groups are likely to be important across a variety of industries. There is also some prima facie evidence of the importance of network ties in machinery procurement decisions: Kreinin (1988) in a survey of Japanese firms' Australian affiliates' capital goods procurement practices found a strong reliance on existing Japanese suppliers, apparently even in the presence of substitutes available on international markets.

To illustrate the potential role of business ties and FDI on trade, we develop a simple model loosely based on Spencer and Qiu (2001) and Head, Ries and Spencer (2004). Suppliers within the business group have undertaken relationship specific investments to supply client firms with specialized, client adjusted, machinery that allows these client firms to reduce manufacturing costs. If the client firm establishes an overseas manufacturing affiliate, it has a relatively large propensity to import machinery from Japan due to the efficiency of the existing supply relationship. Hence, the sunk relationship-specific investments introduce a switching cost (e.g. Hackett and Srinivasan, 1998) that in turn increases trade in case of foreign investment. On the other hand, when the machinery producers of the business group follow their client firm in relocating manufacturing operations abroad, imports are substituted for machinery purchases from the overseas plants of the group machinery firms, and the positive impact on imports of business group ties may disappear. This is not because networks ties are not important, but because network ties are replicated abroad. Empirical analysis of the share of imports in capital goods procurement by 1790 manufacturing affiliates operated abroad by Japanese multinational firms provides broad support for the predictions.

The remainder of this paper is organized as follows. Section 2 reviews the literature on business

network effects in international trade and foreign investments. Section 3 presents the simple model of machinery imports by foreign manufacturing affiliates as a function of business group ties and foreign investments by machinery suppliers within the group. Section 4 describes the data used and Section 5 presents the empirical results. Section 6 concludes and points out some directions for further research.

2. LITERATURE REVIEW

A growing number of studies in the international economics and business literature analyze the role played by business or social networks in international trade and foreign investment, taking a variety of perspectives.[2] Greif (1993) treats social networks as an effective way of enforcing contracts in international trade and hence reducing opportunism. Several other studies emphasize the trade creating effect of networks due to dissemination of information on overseas business opportunities, reducing search costs across firms (Gould, 1994; Head and Ries, 1998; Rauch, 1996, 1999). Other studies examine effects of intra-group trade preferences and their potential exclusionary effects and impact on market barriers (Fung, 1991; Lawrence, 1991, 1993; Weinstein and Yafeh, 1995; Greany, 2005; Spencer and Qiu, 2001; Head et al, 2004; Belderbos and Sleuwaegen, 1998). Studies have examined different types of networks, such as coalitions between traders and their overseas agents (Greif, 1993), immigration links established among members of the same ethnic group (Gould, 1994; Head and Ries, 1998; Combes et al, 2005; Herander and Saavedra, 2005), and business groups such as Japanese keiretsu (Combes et al, 2005; Fung, 1991; Lawrence, 1991; Noland, 1995; Saxonhouse, 1993; Head et al, 2004; Belderbos and Sleuwaegen, 1998).

Theoretical models have been developed to understand the mechanisms through which business networks affect international trade and investment. Rauch (1996) develops a model of trade partner

search and shows how the trade promoting role of networks, in this case Japan's general trading companies (sogo shosha), can be due to economizing on search costs by member firms. Greaney (2003) examines the impact of business networks on both international trade and foreign investment, referring to the asymmetric trade and investment flows between US and Japan and the possible role played by Keiretsu. In her model of multi-product firms with network effects, an equilibrium arises in which the firm from the country with strong network effects invests abroad while the firm based in the non-network country does not, leading to reverse imports from foreign affiliates of the network country firms back to the home market. McLaren (1999) models vertical long-term buyer-seller relationships in international trade and suggests that informal bargaining arrangements such as those frequently adopted among buyers and suppliers within Keiretsu are better able to ensure cooperative investments than formal contracts. Spencer and Qiu (2001) also examine vertical buyer-seller relationship in Keiretsu by analyzing the effect of relationship-specific investments (RSI) by keiretsu parts suppliers. Parts suppliers invest in relationship specific assets that create rents for keiretsu assemblers by reducing assembly costs through their dedicated designs. If these rents are substantial and the suppliers' bargaining power is sufficient to appropriate part of it, relationship specific investments will be undertaken. This RSI leads to a greater reliance on group procurements at home (i.e. in Japan) and a reduced range of parts imported from abroad. The key insight of this model is that network ties and a trade pattern biased against imports can arise endogenously from profit maximizing behavior of firms.

A number of empirical studies of business tie effects on international trade and investment have produced results that are by and large consistent with the predictions of the above theories. Fung (1991) finds that Japanese industries with a higher Keiretsu presence tend to have lower imports propensities,

and similar findings are reported by Lawrence (1991). Noland (1992) finds that a larger Keiretsu presence in industries is associated with higher-than-expected net exports. Belderbos and Sleuwaegen (1998) show that parts producing member firms of vertical keiretsu show a higher propensity to export to Europe if the parent firm has previously invested in the EU. Head et al (2004) test the impact of keiretsu on auto parts trade and explicitly build their model on the work of Spencer and Qiu (2001). They confirm that US auto parts imported by Japan are relatively lower in case Keiretsu parts suppliers are important manufacturers. In addition, investments by Japanese keiretsu suppliers in the US are found to have a positive impact on US part exports, which can be ascribed to reverse imports by Japanese suppliers, consistent with the prediction by Greaney (2003).

On the other hand, a number of studies have disputed the impact of keiretsu on international trade and investment. Saxonhouse (1993) shows the methodological shortcomings of early papers by Fung and Lawrence and suggests that the trade structure of Japan can be explained by its pattern of factor endowment. Ueda and Sasaki (1998) in a study at the firm level find that Keiretsu member firms import no less than non-member firms. Weinstein and Yafeh (1995) suggest that any impact on foreign firms' market entry is likely to stem from tougher competitive conditions in industries with horizontal Keiretsu presence, as group banks push member firms to take up loans and to follow a growth strategy. Miwa and Ramseyer (2002) argue that most of the existing evidence concerning the economic implications of Japanese (horizontal) Keiretsu cannot be readily accepted as they are derived from misspecified econometric equations with unreliable data and problematic classification of Keiretsu membership.

In some contrast, the evidence on the impact of business groups on outward foreign direct investment is relatively strong. Belderbos and Sleuwaegen (1996) find that existing foreign

investments by horizontal and vertical keiretsu firms facilitate further investments by other member firms, which they attribute to information sharing among group member firms, replication of supplier linkages, and a relaxation of capital constraints. Agglomeration of group firm manufacturing investments likewise has a major impact on location choice by member firms (Belderbos and Carree, 2002; Head and Ries, 1996; Pugel and Kimura, 1995; Blonigen et al., 2005; Smith and Florida, 1994; Henisz and Delios, 2001; Chung and Song, 2004; Belderbos, Van Olffen and Zou, forthcoming).[3] This clustering is accompanied by local trade linkages within the business group affiliates in the host countries (e.g. Belderbos et al, 2001

Despite the large number of studies on business ties in international trade and FDI, the impact of business networks on trade patterns by foreign affiliates of multinational firms has not been closely examined. The current study addresses this issue by examining the impact of business groups on capital goods procurement behavior in a large sample of Japanese overseas manufacturing affiliates.

3. A SIMPLE MODEL OF NETWORK EFFECTS ON FOREIGN AFFILIATE IMPORT

We develop a simple model of foreign affiliates' machinery import to illustrate the impact of business group ties within vertical and horizontal Keiretsu, while taking into account potential foreign investment by machinery suppliers within the business groups. We base our model loosely on the models of Spencer and Qiu (2001) and Head et al. (2004), by perceiving group relationships as Relationship Specific Investments (RSI) made by group suppliers to serve client firms within the group with dedicated manufacturing machinery. The RSI creates rents for group buyers through a reduction in the client firm's manufacturing cost. Since the focus of the model is on the impact of foreign manufacturing investments by group machinery suppliers, we treat the presence of RSI as

given. We start from the situation where a manufacturing firm has established an affiliate abroad and has to choose its sources of machinery procurement.

We assume a two-country world, with ***J*** the home country (i.e. Japan) and ***F*** the foreign country. We examine the import behavior of one buyer of machinery, ***B***, which is the foreign affiliate in country ***F*** of a firm based in country ***J***. Buyer ***B*** produces output ***Q*** with one type of machine, each unit of which has the capacity to produce a fixed number of products. Without loss of generality we set this number to one such that demand of buyer ***B*** for machinery equals output level ***Q***.

If buyer ***B*** is an *independent* firm, it has two possible sources of machinery procurement and will choose procurement shares to minimize machinery costs. The firm can choose to import machines from the competitive spot market in home country ***J***, where an independent supplier can supply the machines at a constant price $\mathbf{p}_J$, plus a trade cost ***t***. The other option is to buy from local suppliers in country ***F***. The machinery suppliers in country ***F***, however, have limited production capacity for machinery with the correct quality and specifications, and the price the buyer has to pay for machines produced by local firms increases with the level of its procurement. The supply structure can be envisaged as a continuum of local suppliers ranked according to cost levels. We furthermore assume that the buyer is a monopsonist and pays each local supplier according to its marginal costs[4]. The buyer's marginal procurement costs of local machinery follows the function $c = c_0 + nq_F$, where c_0 indicates the cost of the most efficient local supplier, q_F is the volume of machinery ***B*** buys from local suppliers, and ***n*** is an indicator of local production capacity constraints. The cost-minimizing buyer will procure locally until the marginal cost of local sourcing equals the marginal cost of importing from suppliers in country ***J***: $p_J + t = c_0 + nq_F$. The share of imported machinery by the independent buyer (IND) is:

$$s_{IND} = \frac{Q - q_F}{Q} = 1 - \frac{p_J - c_0 + t}{nQ} \quad (1)$$

The import share decreases with the trade cost ***t*** and the difference between the spot price on the home market and the marginal cost of the most efficient local supplier ***(p_J-c_0)***. The import share increases with the total output level of the buyer, ***Q***, and capacity constraints in local machinery manufacturing indicated by ***n***.

If buyer B is a *business group* member firm, it buys dedicated machinery in the home country from group supplier ***G***. The group supplier has undertaken RSI that creates rents by reducing the buyer's unit production cost by a factor of ***k,*** where ***k*** depends on the level of RSI. To focus our analysis on the impact of RSI, we assume that the manufacturing costs c_G of machinery produced by ***G*** is equal to the home country spot market price p_J. The rent is shared by the buyer and supplier and we assume that a bargaining solution was reached where the buyer obtains a share of the rents indicated by ***μ***. The constant marginal costs of the buyer in case of machinery imports from ***G*** are then given by $c=c_G+t-\mu k$. The cost-minimizing buyer will procure locally until the marginal cost of local sourcing equals that of importing from supplier ***G***: $c_G - \mu k + t = c_0 + nq_F$. The optimal share of imports in machinery procurement of the business group buyer (GRP) is:

$$s_{GRP} = \frac{Q - q_F}{Q} = 1 - \frac{c_G - c_0 - \mu k + t}{nQ} \quad (2)$$

Under the assumption that group suppliers have identical manufacturing costs as independent suppliers

in ***J*** ($c_G = p_J$), it is evident that the group buyer has a greater import share than the independent buyer, due to the factor μk. Business group linkages based on RSI have a trade promoting impact, the magnitude of which is positively related to the level of RSI (***k***) and the share of the rent retained by the buyer (μ).

We now allow for the possibility that the group supplier **G** establishes a manufacturing plant in country ***F*** to serve the group buyer. The foreign investment scenario only arises if the group supplier finds it advantageous to invest abroad.[5] The marginal cost curve of the plant is assumed to take the form $c=c_G+mq_{FG}$, where q_{FG} is the quantity of machines procured by business group firm **B** from the local plant of the group supplier. The parameter ***m*** indicates the capacity constraint of the local plant, which is a declining function of the scale of foreign investment by the group supplier in country ***F***. Apart from avoiding the tariff cost ***t***, the foreign plant is not assumed to have a cost advantage over manufacturing in ***J*** such that the minimum marginal costs are c_G. Marginal cost of buyer ***B*** if it procures from the local group plant are $c=c_G-\mu k+mq_{FG}$.

Insert Figure 1

The cost-minimizing procurement decision of buyer ***B*** is illustrated in Figure 1. The buyer will buy from local suppliers and follow the local marginal cost curve c_0+nq, until the curve intersects at point ***a*** with the marginal cost curve of the local plant of group supplier ***G***, $c_G-\mu k+mq$. The buyer will procure from the local plant of supplier ***G*** until the cost curve intersects at point ***b*** with the import cost line $c_G-\mu k+t$ (q'). The remainder of its procurement $Q-q'$ will be imported.[6] The import share is determined by the intersection at point ***b,*** which satisfies $c_G+t-\mu k = c_G-\mu k+mq'$. The share of

import in total machinery procurement is:

$$S_{GRP,FDI} = \frac{Q - q'}{Q} = 1 - \frac{t}{mQ} \qquad (3)$$

The import share and the share of local procurement from the group suppliers is determined by the tariff rate and the degree of capacity constraints of the group supplier in relationship with the total procurement level of business group firm **B.** Comparing (3) with (1), we see that, in the case of foreign investment by the group supplier, the difference between the import share of the independent firm and the group firm is given by:

$$S_{GRP,FDI} - S_{IND} = \frac{m(c_G - c_0) - (n - m)t}{mnQ} \qquad (4)$$

Equation (4) shows that it is now possible that the import share of the group buyer is smaller than the import share of the independent buyer. This is more likely in particular if the investment in local capacity by the group supplier (the extent of FDI by the supplier) is large (the smaller ***m***). It is also more likely the smaller the cost advantage of suppliers abroad (the smaller $c_G - c_0$), the smaller the production capacity of local independent suppliers (the larger ***n***), and the larger the transport cost (the larger ***t)***.[7]

4. EMPIRICAL MODEL AND DATA

The key prediction of the illustrative model is that foreign affiliates of business group firms are

likely to have a greater propensity to import machinery from Japan, but that this effect is mitigated by investments in foreign manufacturing plants by the group's machinery suppliers. We test this prediction on capital goods procurement data for a large sample of 1790 Japanese manufacturing affiliates abroad, drawing on unpublished information from the official Japanese survey of overseas affiliates.

Data and empirical model

Our main source of data is the basic survey on overseas business activities (MITI, 1996) conducted by the Ministry of Economy, Trade and Industry in fiscal year 1995 (the year ending March 31, 1996). This survey contains detailed information on the overseas affiliates of Japanese firms, including their expenditures on capital goods and the sources of capital goods procurement. The survey is regulated under the Statistics Law of Japan and the responses are seen as representative and include large numbers of major multinational firms. Confidentiality issues restricted access to the fiscal 1995 wave of the survey. Affiliates in the survey report the value of capital goods procured for fixed capital investment projects, and distinguish the sources of capital goods between local procurement and imports from Japan and third countries. We analyze the share of capital goods procurement coming from Japan and examine systematic differences in the reliance on Japanese imports between independent firms and members of horizontal and vertical keiretsu with intra group ties in machinery procurement, and the role played by manufacturing machinery producers within these vertical and horizontal keiretsu.[8] Our sample contains 1790 manufacturing affiliates operated by 685 Japanese firms. More than half of these affiliates reported no capital goods imports from Japan (895), while 147 affiliates report that all capital goods were imported from Japan. Table 1 shows the

country distribution of these affiliates and the average capital goods import ratio from Japan by country or country group[9]. Japanese manufacturing affiliates in developed countries tend to have lower import ratios, which is likely to be related to the availability and quality of local machinery suppliers.

Insert table-1

The dependent variable in the empirical model is the share of imports from Japan in the affiliate's total value of capital goods procurement.[10] Since this variable falls within the range 0-1 we use two-limit Tobit analysis to correct for left and right censoring of the dependent variable. In addition to the business group variables, we include a large set of control variables expected to impact the capital goods import behavior of foreign manufacturing affiliates at the parent and affiliate level, plus a set of country and industry dummies.

Business Groups and intra-group machinery procurement

We obtain information on vertical Keiretsu group affiliation from Toyo Keizai's "affiliated companies data" ("Nihon no Kigyou Guruppu"). This data source contains corporate ownership information on more than 30,000 Japanese firms and is a source of information on vertical business groups. We limit analysis to large groups where the 'core' firm (the firm owning equity stakes in group firms) has at least 500 billion Yen in sales. Horizontal group affiliation data are drawn from Brown & Company's (formerly known as Dodwell Marketing Consultants) "Industrial Groupings in Japan". This data source classifies Japanese firms as belonging two one of the eight horizontal business groups, i.e. the Mitsubishi, Mitsui, Sumitomo, Fuyo, DKB, Sanwa, Tokai, and IBJ group.

Group membership as such is not a defining characteristic of our model and test. The concept of RSI suggests that the analysis should only focus on group membership if it involves long-standing buyer-supplier linkages between the member firm (buyer) and machinery suppliers within the group. A first condition for this to hold is that the group should include member firms producing manufacturing machinery, which we investigated using the above mentioned publications and the Japan Company Handbooks. All horizontal groups included manufacturing machinery producers, but many smaller vertical groups or vertical groups in specific industries such as food processing, did not. A second condition is that there are important intra-group supplier-buyer relationship with respect to manufacturing machinery trade. We used Nihon Keizai Shimbun's "Kigyou Keiretsu Souran" (Handbook of Business Groups) to investigate what the main buyers were of the identified machinery producers that were members of a business group. The Nihon Keizai Shimbun publication lists for each firm the five most important customers (client firms). This allows us to measure within-group supplier-buyer relationships at the affiliate level: we count the number of times that the Japanese parent firm of a foreign manufacturing affiliate was listed as a major client of intra-group machinery firms. This count can be considered a firm-level measure of the intensity of intra-group machinery procurement likely to involve relationship-specific investments. A drawback of this fine-grained measure, on the other hand, is that several (smaller) group firms that may be dependent on within-group machinery suppliers are not observed because they are not among the top five biggest clients because of a more limited procurement volume. We therefore also examine the impact of group membership on affiliate procurement if the investing parent firm is not listed as major client of within-group machinery suppliers. We do apply a further restriction in this case: we only consider vertical groups if at least one of the group manufacturing machinery suppliers reports other group

firms among its major clients. For horizontal keiretsu this was always the case. For vertical keiretsu, this procedure traced 19 groups with important intra-group machinery procurement. In sum, we examine whether affiliate procurement behavior is different for parent firms' that are member of one of the 8 horizontal or 19 vertical business groups, and for parent firms that are among the major clients of within-group machinery firms.

In order to test the prediction that he impact of intra-group machinery trade relationships is moderated by the extent to which within-group machinery firms have invested in machinery production facilities abroad, we traced the foreign manufacturing affiliates of all group machinery producers in Toyo Keizai's "directory of overseas Japanese companies". Based on this source, which has a rather complete coverage of overseas affiliates of Japanese firms, we established the number and location of overseas machinery manufacturing plants.

Independent Variables

We include two dummy variables, *vertical group* and *horizontal group*, indicating membership of one of the vertical or horizontal business groups as defined above. 434 affiliates abroad were operated by parent firms with vertical group links and 595 affiliates belong to parent firms with horizontal group links. Of these affiliates, 190 belong to parents that are members of both a horizontal and vertical group. In those cases both dummy variables get the value 1. We also include further detail on the intensity of within group machinery supply linkages through the variables "*Vertical machinery client*" and "*Horizontal machinery client*", which are the number of occurrences that the parent firm was listed as major client of machinery manufacturing firms in its business group. For each business group, we count the number of overseas machinery-manufacturing affiliates established by group

member firms as "*Vertical machinery FDI*" and "*Horizontal machinery FDI*", respectively. Counting the total number of overseas manufacturing affiliates is consistent with our two country setting (Japan vs. 'abroad') and is the preferred specification if we assume that foreign affiliates of group members can be supplied by any group-owned machinery plant abroad. Given the high value to transport cost ratio in machinery trade, a broad geographic market mandate of overseas machinery plants is quite common. On the other hand, one can expect the impact of group machinery plants located in the same country as the affiliate to be larger. We therefore also split the FDI variables into the number of overseas machinery-manufacturing affiliates established in the same host country as the focal affiliate ("*Vertical machinery FDI host*", "*Horizontal machinery FDI host*") and the number of machinery manufacturing affiliates in the rest of the world ("*Vertical machinery FDI other*", and "*Horizontal machinery FDI other*").

We include a broad set of control variables. "*Parent firm size*" is the logarithm of the number of employees of the Japanese parent firm in 1995. Large firms have more financial and management resources to explore international procurement channels and may be in a better bargaining position vis-à-vis those suppliers. We expect affiliates of large parent firm to exhibit a lower level of machinery imports from Japan. We also include a dummy variable "*Parent machinery firm*" which takes the value 1 if the Japanese parent firm is producing manufacturing machinery. Given that these firms may develop their own manufacturing machinery in-house, the Japan import ratio is likely to be higher. On the other hand, this effect may be limited if the firm has invested in machinery plants abroad - in case these overseas plants also supply other overseas affiliates of the parent. We include the variables "*Parent machinery FDI*", "*Parent machinery FDI host*", and "*Parent machinery FDI other*".

We included five affiliate level variables. "*Affiliate size*" is the logarithm of the number of

employees of the affiliate. The arguments for inclusion of this variable are similar to the arguments that apply to parent size. "*Affiliate age*" is the number of years that a focal affiliate had been in operation prior to the year 1996. In particular in the early years after establishment, investing firms are likely to rely on machinery imported from the home country. In later years, experience in finding suitable local suppliers and working with these to adapt machinery and service to suit the firms' need, should make it easier to buy from local machinery suppliers (e.g. Belderbos et al, 2001). "*Affiliate Japanese ownership"* is the logarithm of the equity stake held by Japanese parent firms in an affiliate. With lower equity stakes (joint ventures with local partner firms or with third country partner firms) international or local machinery procurement is more likely, for instance because the partner firms may have existing machinery suppliers it has been working with. *"Affiliate local sales*" is a dummy indicating whether the focal affiliate is local market oriented or not. Affiliates established to serve the local market may have a greater need to adapt their product to the local market, which may require tailored machinery for local manufacturing. The last affiliate characteristic is "*Affiliate total machinery procurement*", the logarithm of the yen value of total capital procurement made by the affiliate. The model suggests that the larger the level of procurement, the less likely it is that local suppliers can serve the demand of the Japanese buyers, and the higher the share of imported machinery from Japan. In addition, large value purchases may involve more sophisticated machines that are more likely to be imported from Japan.

The empirical model also includes a set of 25 country dummies and 13 industry dummies (based on the industry classification of foreign affiliates provided in the MITI survey). The description and summary statistics of the variables are provided in Table 2, and the correlation matrix is given in the appendix.

Insert table-2

5. EMPIRICAL RESULTS

Empirical results of Tobit analysis of the ratio of capital goods imports from Japan to total capital goods procurement by Japanese manufacturing affiliates abroad are presented in Table 3. The table contains the results of four models. Model 1 only includes the horizontal and vertical group dummies, Model 2 adds the firm-specific indicators of within-group supplier-buyer trade. Model 3 adds the foreign investments of group machinery firms, and model 4 splits these investments (number of machinery manufacturing affiliates) in host country investments and investments in the rest of the world. All 4 models are highly significant as indicated by the Chi-square test statistic. Loglikelihoodratio test showed that the fit of the model significantly improves from model 1 up to model 3, but that the change from model 3 to model 4 is no significant improvement.

Overall, the key predictions that we derived from the simple model find support in the empirical results. In model 1, the *Vertical group* dummy is positive and highly significant, while the *Horizontal group* dummy is positive but insignificant. In model 2, the coefficient of *Vertical machinery client* is not significant, but its inclusion does not affect the significance of the vertical keiretsu dummy. The variable *Horizontal machinery client* in contrast is highly significant and positive. The full specification is in models 3 where the analysis incorporates the potential mitigating impact of group machinery investments abroad. In model 3, *Horizontal group is* now positive and significant (at the 10 percent level), while the impact of horizontal business groups on imports from Japan is further strengthened for major machinery client firms within the group:

Horizontal machinery client remains positive and highly significant. The *Vertical group* coefficient increases substantially in size and remains strongly significant, while again there is no additional impact for reported major machinery clients within the group.[11] Model 3 also confirms the mitigating impact of machinery investments, as both *Vertical machinery FDI* and *Horizontal machinery FDI* are negative and significant. In model 4, the results do not suggest a greater impact on imports from Japan of co-located manufacturing plants of group machinery suppliers. Both *Vertical machinery FDI host* and *Horizontal machinery FDI host* have the expected negative sign but are insignificant, while *Vertical machinery FDI other* and *Horizontal machinery FDI other* are negative and significant. These results are consistent with a wider geographic mandate for group machinery manufacturing plants abroad, which serve group clients in several countries abroad.

The estimated coefficients indicate that for vertical group member firms, the import increasing impact of membership is completely neutralized if group machinery firms have established more than 20 manufacturing affiliates abroad. This is the case for 7 out of 19 vertical keiretsu in our sample. In these cases business group membership *reduces* home country trade bias through foreign direct investment by group machinery firms. For horizontal business groups, the intersection point for member firms is at 22 overseas machinery manufacturing affiliates, which is reached by all but one of the 8 horizontal keiretsu. However, for major client firms this intersection point is substantially higher, depending on the number of identified links, with a resulting positive impact on imports from Japan.

It is also of interest to evaluate the magnitude of the impact of business group buyer-supplier linkages on machinery imports. Due to the censoring of the dependent variable, the marginal

effects are smaller than the estimated coefficients. The calculated marginal effects indicate that vertical business group membership increases the Japan machinery import ratio of a foreign affiliate by 8 percent points, while horizontal business group membership increases the ratio by 4 percent points. For horizontal business groups, each identified buyer-supplier linkage of the parent firm increases the import ratio further by 4 percent points. As the maximum number of links reported for horizontal business group parents in the sample is two, the impact of horizontal business groups can reach 12 percent points. On the other hand, an additional foreign machinery manufacturing affiliate established by machinery firms in a horizontal group would reduce the import ratio by 0.2 percent points; this reduction is 0.4 percent points for vertical business groups. These impacts are not trivial and apply to the capital goods procurement budgets of hundreds of foreign affiliates.

The estimated impacts of the control variables generate few surprises and are largely in line with expectations. *Parent firm size* is negative and highly significant in all specifications, as is *affiliate size.* The *Parent firm machinery* dummy has the expected positive sign, but is insignificant; the FDI variables for machinery parents are similarly insignificant. *Affiliate age* is negative and highly significant, while *Affiliate Japanese ownership* is positive and highly significant in all models, as expected. *Affiliate total machinery procurement* is positive and highly significant, consistent with the stylized model and the view that larger values of procurement are more likely to involve more sophisticated equipment that needs to be imported from Japan. The *Affiliate local sales* dummy variable has the expected negative sign but its coefficient is not significant.

6. CONCLUSIONS

In this paper we developed a simple illustrative model of the impact of buyer-supplier relationships within business groups on machinery procurement by foreign manufacturing affiliates. Machinery suppliers within the business group undertake relationship specific investments to supply client firms within the group with specialized machinery that allows client firms to reduce costs. If the client firm establishes an overseas manufacturing affiliate, it has a relatively large propensity to import from Japan due to the efficiency of the existing supply relationship. Hence, the sunk relationship-specific investments introduce a switching cost that in turn increases trade in case of foreign investment. On the other hand, when the machinery producers of the business group also relocate manufacturing operations abroad, imports are substituted by machinery purchases from the overseas local plants of the group machinery firms. The positive impact of business group ties on imports may disappear or can even be transformed into a negative impact. Hence, one may find no systematic relationship between business group ties and trade, not because business group ties are not important, but because intra-group ties are replicated abroad.

We then test our predictions from the model on an extensive dataset of 1790 foreign manufacturing affiliates of Japanese multinational firms in 1996. Tobit analysis of the share of imports from Japan in capital goods procurement of these manufacturing affiliates provides broad support for the key predictions. Affiliates of member firms of horizontal and vertical business groups (keiretsu) exhibit a greater propensity to import from Japan, but this impact is mitigated or transformed into a smaller propensity to import from Japan for keiretsu of which the intra-group machinery producers have substantial manufacturing investments. Machinery manufacturing investments abroad in general,

rather than machinery manufacturing investments in the same host country of the affiliates, were found to negatively impact group firms imports from Japan, suggesting that overseas machinery plants have a wide geographic mandate. The impact of foreign machinery investments transforms the business group impact on imports from a positive into a negative effect for about one third of the vertical keiretsu and for most horizontal keiretsu members that were not identified as having the most substantial ties with group machinery manufactures. The potential estimated impacts of supplier-buyers linkages within vertical and horizontal business groups are not trivial: they range between 8 and 12 percent points difference in the share of imports from Japan and apply to capital good procurement budgets of hundreds of foreign affiliates.

Our findings suggest that business groups are likely to have a larger effect on trade than can be observed by simply relating business group (*keiretsu*) membership at the firm or industry level to trade propensities, an approach which a number of previous studies have pursued (e.g. Noland, 1992; Ueda and Sazaki, 2002). Empirical investigation of the role of business network should take into account that intra-group trade relationships impact both trade and foreign investment, with ambiguous outcomes for total trade flows. In this sense, our analysis of overseas affiliate imports (i.e. exports from Japan) are more in line with studies of Japanese imports by Head et al (2004) and Greaney (2003; 2005) that include consideration of foreign direct investments.

A number of avenues for further research are open, of which we mention three. First, long-standing buyer-supplier relationships may also be present outside vertical and horizontal business groups. In principle, it is possible to investigate if any firm operating foreign affiliates is listed as a major client of manufacturing machinery producers in Japan, and to collect data on these producers' investments abroad, although this would be a major labor intensive exercise. Second, another possible

extension would be to simultaneously model and analyze machinery imports and FDI decisions by client firms and suppliers within the group. This would require more complex modeling, and empirically, the adoption of a simultaneous equation framework. Third, data limitations prevented us from studying later surveys among Japanese affiliates abroad. Although recent studies do not suggest that the specificity of Japanese trade patterns, such as the reliance of foreign affiliates on trade with Japan, is reducing (Greany, 2009), strengthened competences of foreign firms and increased efforts to reduce costs through standardization (e.g. Paprzycki, 2005) may have reduced the importance of existing Japanese buyer-supplier linkages for overseas affiliates. Replication of this type of study for a sample of affiliates in a more recent period would throw more light on the evolving role of Japanese business groups in international trade.

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Figure 1. The machinery procurement decision of group buyer B in case of FDI by the group supplier

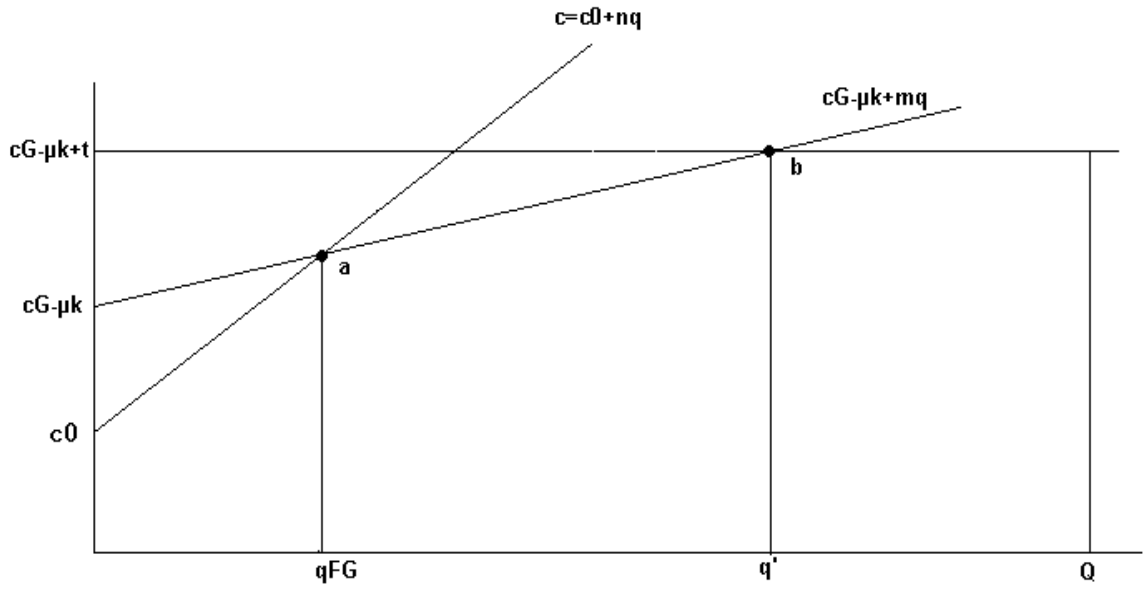

Table 1 Country distribution of Japanese foreign manufacturing affiliates and average share of capital goods import from Japan

County or Country groups	**No. of affiliates**	**Average Jap import Ratio) (%**
Belgium & Luxembourg	13	3.19
France	24	3.71
Austrlia&New Zealand	22	7.67
The Netherlands	15	8.67
Spain	20	9.50
Italy	10	10.80
South America*	8	12.01
South Korea	100	14.77
Canada	16	16.26
Great Britain	73	19.10
United States	404	19.31
Germany	47	19.89
India	17	22.24
Brazil	32	25.63
EU other**	13	26.68
Taiwan	137	27.55
Singapore	104	30.52
Mexico	23	30.79
Malaysia	133	35.05
Indonesia	99	36.39
Hong Kong	62	39.37
Thailand	150	39.55
Philippines	38	41.45
China	223	44.37
Vietnam	7	60.57
Total	*1790*	*28.17*

* South America includes: Ecuador, El Salvador, Guatemala, Venezuela, and Peru;

** Europe other includes: Denmark, Finland, Greece, Sweden, Portugal, and Ireland;

Table 2
Description and summary statistics of dependent and explanatory variables

Name	Description	Mean	Stdev
Machinery import ratio	Share of import from Japan in total capital good procurement of the focal affiliate in 1995	0.28	0.36
Vertical group	Dummy taking value 1 if the focal affiliate belongs to a vertical business group of which the core firm has annual sales of more than 500 billion Yen, at least one group machinery supplier, and at least one identified trade link between an intra-group machinery suppliers and group member firms.	0.24	0.43
Vertical machinery client	Number of times the parent firm of a focal affiliate is listed as major client of machinery firms in a the vertical business group	0.09	0.37
Vertical machinery FDI	The number of overseas machinery manufacturing affiliates belonging to vertical group member firms	2.05	4.79
Vertical machinery FDI host	The number of machinery manufacturing affiliates belonging to vertical group member firms in the host country	0.19	0.58
Vertical machinery FDI other	The number of overseas machinery manufacturing affiliates belonging to vertical group member firms, except for affiliates in the host country	1.85	4.39
Horizontal group	Dummy variable taking the value 1 if the focal affiliate is member of one of the eight large horizontal business groups, which have at least one intragroup machinery supplier, and at least one identified trade link between intragroup machinery suppliers and member firms.	0.33	0.47
Horizontal machinery client	Number of times the parent firm of a focal affiliate is listed as major client of machinery firms in a horizontal business group	0.06	0.26
Horizontal machinery FDI	The number of overseas machinery manufacturing affiliates belonging to horizontal group member firms	8.06	12.36
Horizontal machinery FDI host	The number of machinery manufacturing affiliates belonging to horizontal group member firms in the host country	0.73	1.50
Horizontal machinery FDI other	The number of overseas machinery manufacturing affiliates belonging to horizontal group member firms, except for affiliates in the host country	7.33	11.33
Parent firm size	Logarithm of total employment of the Japanese parent firm of a focal affiliate in 1996	7.64	1.80
Parent machinery firm	Dummy taking value 1 if the Japanese parent firm of a focal affiliate is machinery manufacturing	0.12	0.32
Parent machinery FDI	The number of machinery manufacturing affiliate belonging to parent firms in all foreign countries	0.67	1.80
Parent machinery FDI host	The number of machinery manufacturing affiliate belonging to parent firms in the focal host country	0.12	0.35
Parent machinery FDI other	The number of machinery manufacturing affiliate belonging to parent firms in all foreign countries except for focal country	0.55	1.59
Affiliate size	Logarithm of total employment of the focal affiliate in 1996	5.07	1.42
Affiliate age	Logarithm of the number of years that a focal affiliate had been in operation prior to year 1996	2.18	0.75
Affiliate Japanese ownership	logarithm of the percent equity share held by Japanese parent firms in an affiliate	-0.37	0.56
Affiliate total machinery procurement	Logarithm of the Yen value of total capital procurement made by affiliate in 1995	4.66	1.93
Affiliate local sales	Dummy variable indicating whether the focal affiliate sells it output on the local market	0.26	0.44

Table-3 Tobit model of machinery import of Japanese foreign manufacturing affiliates

	Model 1	Model 2	Model 3	Model 4
Vertical group	0.2552	0.2228	0.406	0.4108
	[0.0480]***	[0.0510]***	[0.0745]***	[0.0749]***
Vertical machinery client		-0.0041	-0.0015	-0.0042
		[0.0548]	[0.0554]	[0.0555]
Vertical machinery FDI			-0.0193	
			[0.0059]***	
Vertical machinery FDI host				-0.0565
				[0.0409]
Vertical machinery FDI other				-0.0161
				[0.0069]**
Horizontal group	0.0407	0.0113	0.1902	0.1893
	[0.0470]	[0.0482]	[0.1040]*	[0.1048]*
Horizontal machinery client		0.2248	0.2133	0.2141
		[0.0769]***	[0.0782]***	[0.0783]***
Horizontal machinery FDI			-0.0091	
			[0.0041]**	
Horizontal machinery FDI host				-0.0089
				[0.0183]
Horizontal machinery FDI other				-0.0091
				[0.0044]**
Parent firm size	-0.0727	-0.0751	-0.0733	-0.0735
	[0.0133]***	[0.0134]***	[0.0133]***	[0.0133]***
Parent machinery firm	0.0563	0.0136	0.0494	0.0475
	[0.0658]	[0.0683]	[0.0700]	[0.0707]
Parent machinery FDI	0.017	0.0162	0.0075	
	[0.0123]	[0.0126]	[0.0130]	
Parent machinery FDI host				0.0122
				[0.0637]
Parent machinery FDI other				0.0082
				[0.0151]
Affiliate size	-0.0407	-0.0426	-0.0444	-0.0442
	[0.0171]**	[0.0171]**	[0.0170]***	[0.0170]***
Affiliate age	-0.0849	-0.0835	-0.079	-0.0808
	[0.0297]***	[0.0296]***	[0.0295]***	[0.0296]***
Affiliate Japanese ownership	0.147	0.1452	0.1463	0.1466
	[0.0341]***	[0.0340]***	[0.0338]***	[0.0338]***
Affiliate total machinery procurement	0.1208	0.1216	0.122	0.1221
	[0.0124]***	[0.0124]***	[0.0123]***	[0.0123]***
Affiliate local sales	-0.0616	-0.0602	-0.0634	-0.0626
	[0.0429]	[0.0427]	[0.0425]	[0.0425]
Constant	-0.8075	-0.7409	-0.7397	-0.7414
	[0.2425]***	[0.2419]***	[0.2405]***	[0.2413]***
Country dummies	Included	Included	Included	Included
Industry dummies	Included	Included	Included	Included
Log likelihood	-1372.76	-1368.50	-1360.83	-1360.38
LR Chi-square	544.36***	552.88***	568.22***	569.11***
Observations	1790	1790	1790	1790

Notes: Robust standard errors within parentheses; * significant at 10%; ** significant at 5%; *** significant at 1%

Appendix: Correlation matrix

		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
1	Machinery import ratio	1.00																				
2	Vertical group	0.12	1.00																			
3	Vertical machinery client	0.01	0.43	1.00																		
4	Vertical machinery FDI	0.03	0.76	0.39	1.00																	
5	Vertical machinery FDI host	0.05	0.59	0.27	0.72	1.00																
6	Vertical machinery FDI other	0.03	0.75	0.39	1.00	0.65	1.00															
7	Horizontal group	-0.04	0.13	0.14	-0.04	-0.02	-0.05	1.00														
8	Horizontal machinery client	0.10	0.38	0.23	0.16	0.15	0.15	0.35	1.00													
9	Horizontal machinery FDI	-0.04	0.14	0.06	-0.05	-0.02	-0.06	0.92	0.39	1.00												
10	Horizontal machinery FDI host	-0.01	0.09	0.06	-0.04	0.01	-0.04	0.69	0.30	0.72	1.00											
11	Horizontal machinery FDI other	-0.04	0.14	0.05	-0.05	-0.03	-0.05	0.92	0.38	1.00	0.65	1.00										
12	Parent firm size	-0.03	0.46	0.30	0.30	0.23	0.29	0.39	0.31	0.37	0.26	0.37	1.00									
13	Parent machinery firm	0.05	0.22	0.01	0.06	0.09	0.05	0.35	0.36	0.41	0.29	0.40	0.20	1.00								
14	Parent machinery FDI	0.02	0.32	0.32	0.22	0.24	0.21	0.04	0.21	-0.01	0.00	-0.01	0.30	0.36	1.00							
15	Parent machinery FDI host	0.02	0.21	0.18	0.15	0.30	0.12	0.05	0.16	0.01	0.05	0.01	0.18	0.36	0.66	1.00						
16	Parent machinery FDI other	0.01	0.32	0.32	0.21	0.20	0.21	0.04	0.21	-0.01	-0.01	-0.01	0.30	0.33	0.99	0.52	1.00					
17	Affiliate size	0.12	0.16	0.07	0.12	0.10	0.12	0.03	0.10	0.04	0.04	0.04	0.32	0.02	0.08	0.03	0.08	1.00				
18	Affiliate age	-0.19	-0.04	0.00	0.01	-0.08	0.02	0.03	0.00	0.02	-0.04	0.03	0.14	0.01	0.04	-0.02	0.05	0.23	1.00			
19	Affiliate Japanese ownership	0.06	-0.01	-0.03	-0.05	-0.04	-0.05	0.00	0.00	0.02	0.02	0.02	-0.03	-0.01	-0.04	-0.03	-0.03	-0.10	0.03	1.00		
20	Affiliate total machinery procurement	0.18	0.15	0.10	0.13	0.12	0.13	0.08	0.06	0.07	0.10	0.06	0.34	-0.03	0.02	0.01	0.02	0.57	0.02	-0.02	1.00	
21	Affiliate local sales	-0.06	-0.05	-0.01	0.00	0.03	0.00	-0.05	-0.05	-0.06	-0.04	-0.06	-0.01	-0.05	-0.01	0.01	-0.02	-0.11	-0.07	-0.11	0.00	1.00

ENDNOTES

[1] A partial exception in terms of theory is Greaney (2003). Extending the analysis of business ties to foreign direct investment in a two country model, her findings suggest that the country with a stronger presence of business groups will exhibit larger outward investments with foreign affiliates engaged in exports to Japan.

[2] A related literature has examined the performance consequences of business group membership and the role of business groups in relaxing credit constraints (e.g. Hoshi et al, 1991; Khanna and Palepu, 1999; Khanna and Rivkin, 2001; Weinstein and Yafeh, 1995).

[3] Much weaker evidence has been found for the impact of keiretsu on inward direct investments in Japan. Lawrence (1992) finds that industries with a higher Keiretsu presence exhibit lower shares of foreign affiliate sales, but Weinstein (1996) suggests that an inward investment inhibiting impact is mainly due to the difficulty in hiring personnel. Utilizing data on foreign affiliate presence at the 3 digit industry level, Fukao (2003) finds that Japanese Keiretsu do not act as impediment to inward investments. Yamawaki (2004) adds evidence that the survival of affiliates of foreign firms in Japan is not affected by the presence of Keiretsu in the industry.

[4] Alternatively, one could assume that the buyer pays one spot market price $\boldsymbol{P_F = c_0 + nq_F}$ such that total rather than marginal procurement costs increase in the volume of purchases. This would not change the essence of the analytical results.

[5] It is easily shown that this will depend on the value of $\boldsymbol{k}$ under the assumption of a fixed setup cost of FDI.

[6] In Figure 1 it is assumed that the most efficient local supplier enjoys a cost advantage vis-à-vis the supplier in $\boldsymbol{J}$ ($\boldsymbol{c_0 < P_J}$.), and that m<n such that there is a positive value for procurement from the local

plant of the group supplier. This is consistent with the rationale for group supplier ***G*** to invest abroad.

[7] The higher the tariff, the more advantageous it becomes to source from the local plant of the group supplier rather than to import from the group supplier.

[8] We use the terms machinery imports and capital goods import interchangeably. Capital goods procurement may also partly consist of building materials for new plants. We expect little systematic variation in the share of these other expenditures besides general differences between industries. This would suggest that the variation will be picked up by the industry dummies, and that the focus on machinery suppliers is not likely to reduce the accuracy of our estimates.

[9] Dummies for countries that have very few observations (less than 5) are aggregated with other small country dummies in the same region.

[10] The dependent variable is a value share, but our theoretical model gives predictions concerning volume shares of imports. Developing the model in value share terms would not alter the substance of the predictions, while the derivations would substantially increase in complexity.

[11] This may be related to our imperfect measurement of buyer-suppliers linkage in the group. Compared with horizontal business group firms, vertical business group member firms are smaller on average and are less likely to be listed as top five clients of group machinery firms, making this a much less differentiating feature of intensive buyer-supplier linkages within vertical groups.

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